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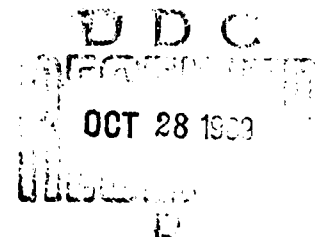
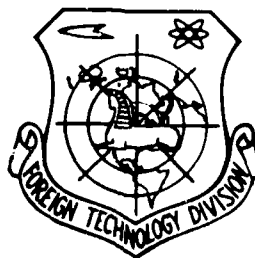
## FOREIGN TECHNOLOGY DIVISION



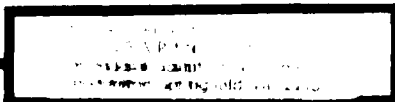
NEW LIQUID COOLANT-LUBRICANTS

by

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<p>ABSTRACT: The newest developments in domestic and foreign production of cutting fluids are reviewed. Total production of self-emulsifying oils in 1967 was 133 000 tons, amounting to about 20 kg per year per machine worker. Recent developments include sulfonate-based self-emulsifying oils "NGL-205" and "SDMu," fluids V-32K, V-35, V-29B, for difficult to handle metals, and V-31 for aluminum and magnesium alloys. Large numbers and amounts of cutting fluids are being produced abroad. They belong to the following categories: soluble oils and self-emulsifying oils for preparation of emulsions without additives; soluble oils and self-emulsifying oils with sulfur, chlorine, or phosphorus; soluble oils and self-emulsifying oils containing molybdenum disulfide, with or without other additives; true solutions based on organic or inorganic nitrates or other corrosion inhibitors; chemical fluids with wetting additives; mineral oils; chlorinated mineral oils; etc. Considerable work must be conducted in testing new cutting fluids, determining application areas, disseminating information on uses, support of new institutions and laboratories specializing in the study of these materials, and in toxicological testing of these compounds for the safety of employees working with cutting fluids.</p>				

## NEW LIQUID COOLANT-LUBRICANTS

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The technical development of the mechanical processing of metals by cutting, connected with a sharp increase in the number of workable metals, the continued increase in quality and accuracy of finished surfaces, and the automation of technical processes demand a significant broadening in the nomenclature of liquid coolant-lubricants (SOZh). This is especially required since widely and universally designated SOZh, equally effective in all cases, do not exist. These liquids and the methods of their application, highly effective for one group of processed materials and operations, display little effectiveness or are completely unsuitable for other groups. Even in the processing of one and the same material the effectiveness of SOZh changes, depending on tool material qualities and on cutting conditions and may be contrary to the desired effect.

Oils and water-oil emulsions are the basic types of SOZh in our country. Oil refineries in our country produce large quantities of emul'sols<sup>1</sup> prepared in naphthenic acids of oil acidol or talloil, and sulfurated mineral oil -- sul'fofrezol [petroleum oil mixed with sulphur and used as cutting oil]. In 1967 there will be 133,000 tons of emul'sols and sul'fofrezol centrally produced, which will amount to approximately 20 kg per year for each worker engaged in machine construction.

In addition to sul'fofrezol and emulsions prepared on a base of emul'sols and distributed centrally, machine construction and instrument manufacturing enterprises employ as SOZh, or as separate components in SOZh manufacture, mineral oils, kerosene, oxidized petrolatum, Petrov contact<sup>2</sup>, OP-7 and OP-10 wetting agents, soap, soda, sodium nitrite, triethanolamine, calcium chloride, oleic acid, chlorinated paraffin, carbon tetrachloride, animal fats, alcohols, colloidal graphite, molybdenum disulphide and others.

During the last  $1\frac{1}{2}$  to 2 years, significant successes in the development of new SOZh have been achieved. The Moscow factory "Neftegaz" with ZIL [I. A.

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<sup>1</sup>See p. 8.

<sup>2</sup>See p. 8.

Likhachov Automobile Plant] originated and organized the production of new emul'sols in sulphonates NGL-205 and SDMu VNII [ALL-UNION SCIENTIFIC RESEARCH INSTITUTE] of the oil industry with NIAT [Scientific Research Institute of Aviation Technology] and the Leningrad Shaumyan factory originated V-32K, V-35, V-29B liquids for metals difficult to work and V-31 for aluminum and magnesium alloys: The Perm Oil and Lubricant Plant mastered their production. Several new SOZh compounds were developed by the Gorky Oil and Lubricant Plant named for 26 Baku Commissars. The Ivanov Chemical Factory named for Baturin is developing SOZh on the base of "BV" lubricating agent and several surface-active substances. A special laboratory for the development of new SOZh was created in 1964 within the All-Union Scientific Research and Construction-Design Institute of Oil Chemistry in Kiev. The production organization of the new SOZh, in particular those with an admixture of high-pressure (VD) additives, undoubtedly has a great deal of significance. But this is only the first step in the satisfaction of the urgent demand by mechanical engineers for liquids required in the mechanical working of various materials, and most important, for hard-to-work metals. To say nothing of the fact that all these SOZh themselves still require further development, they cannot, in principle, solve the problem as a whole. Even after their distribution on a large scale is accomplished, effective SOZh will not be provided for such groups of hard-to-work materials as cast iron, some titanium alloys, refractory metals and alloys, magnetic and low-magnetic alloys, and also for such forms of machining of hard-to-work materials as fine polishing, honing, and lapping.

In order to process metals through cutting abroad, a large number of various SOZh are produced: They may be divided into the following groups.

Solute oils and emul'sols for the preparation of emulsions of various concentrations without supplementary additives. These are employed for processing operations at high speeds and relatively low pressures; for the processing of stainless steels with a hard-alloy tool; for the turning and final milling of low-alloy high-strength steel, martensitic stainless steel, and molybdenum. The anti-corrosion and lubricating properties are improved with an increase in the oil concentration.

Solute oils and emul'sols with VD additives, containing sulphur, chlorine, phosphorus for the preparation of emulsions of different concentrations. These are employed in operation with relatively high speeds and increased pressures;

during the processing of heat-resistant steels and titanium, and in the polishing of cast iron with globular graphite.

Solute oils and emul'sols containing molybdenum disulphide with VD additives or without them. These are intended for the execution of especially difficult operations (internal broaching, the machining of slots and thread cutting); and for machining parts made from exceptionally ductile and strong steels and alloys.

Solute oils and emul'sols containing fat additives together with VD additives or without them. These are employed in processing heat-resistant alloys with increased strength and malleability, and also for aluminum and its alloys.

True solutions (chemical liquids) based on organic and inorganic nitrates, and also on other corrosion inhibitors. These are employed in the grinding of cast iron, of a hard alloy tool and its sharpening, in precision grinding in other forms of processing for ferrous and non-ferrous metals, except for thread and groove cutting on multi-edge tools, during grinding of the alloy: 80% columbium + 10% molybdenum + 10% titanium. However, the operation of the turrets and the sliders is impeded due to the formation of residues (after water evaporation) within them.

Chemical liquids with lubricating additives. These are intended for grinding, for work with cutting tools of high-speed steel, and for hard-alloy tools.

Chemical liquids with lubricating additives, and also with chlorine, sulphur and phosphorus. These are employed during the machining of ferrous metals and many aluminum alloys, and also during work with high-speed and hard-alloy cutting tools.

Mineral oils. These are employed under light duty conditions in the processing of aluminum, magnesium, brass and for threading in "white" metals (babbitt), and for belt polishing of stainless steels.

Mineral oils with fat additives. These are intended for the machining of magnesium, aluminum and non-ferrous metals; for the belt polishing of carbon steels; for the processing of parts on automatic screw cutting machines, copper and its alloys (sharpening, threading); and also for the processing of parts, subjected to subsequent case hardening.

A sulfurated-chlorinated mixture of fats and mineral oils. These are employed in the processing of non-ferrous metals, especially in those cases when a surface with a small degree of roughness is required. This mixture is usually employed in shops where ferrous and non-ferrous metals are processed on the same machines, on multi-spindle automatic bar machines and chucking semi-automatic machines, as a "cutting" and hydraulic fluid and for machine lubrication: It is used during the machining of cast iron with globular graphite. The significant anti-welding properties of sulfurated-chlorinated mixtures of fats and mineral oils are especially important during cutting operations, when high pressure may occur, and as a result excessive instrument vibration is possible.

Sulfurated mineral oils. These are employed in cutting low-carbon steels and other high-ductility metals with poor machinability; for malleable metals; for threading and broaching operations on heavy lathes for metals possessing high malleability and ductility, and also for turning, milling, drilling and threading of cast iron.

Sulfurated mineral oils with the addition of chlorine compounds. These are employed during the threading of parts of mild drawn steels, the cutting of hard-to-work steels and chromium-nickel alloys; for the turning of titanium alloys, of martensitic stainless steel of increased strength, and high-alloy austenitic stainless steel; during hole reaming and thread cutting in HRC 28-52 steels; for drilling and polishing of heat-resistant alloys on a nickel and cobalt base; and during the processing of delicate and precision steel and brass clockwork parts.

Chlorinated mineral oil. These are employed during the drilling, milling, and turning of mild and malleable materials, and also for the cutting of stainless steels; during the processing of stainless steels, low-alloy steels, heat-resistant alloys on a nickel and cobalt base, molybdenum and cast iron; during drilling, grinding and thread-cutting in a titanium alloy; in a tantalum-tungsten alloy (90 + 10%) and in pure tungsten (92-98%); and during final milling and thread-cutting in the alloy: 80% columbium + 10% molybdenum + 10% titanium.

Sulfurated mineral oils in a mixture with sulfurated-chlorinated fatty oils. These are intended for an especially difficult condition in the cutting

process.

The production of all these groups of SOZh has been mastered and they have been employed abroad for a comparatively long time. Regarding the newer SOZh compounds, in particular, those of water solutions of synthetic components with a high molecular weight (synthetic emulsions), information concerning these is so far insufficiently defined, just as for liquids on the basis of organic compounds and other effective SOZh.

According to recent press reports from abroad, another class of SOZh has been produced. In this connection the opinion has been expressed that such liquids permit a significant alleviation in the difficulties of processing titanium and a series of other metals: thus the employment of materials possessing excellent operating characteristics will obtain a new impetus in various areas of technology.

It is necessary to carry out a series of measures in our country with the aim of broadening the SOZh inventory and of improving their qualities. First it is necessary to conduct complex tests of the new centrally manufactured SOZh and to determine specific areas for their application. This work has already been assigned to the Scientific Research Machine Tool Building and Instrument Laboratory of the Gorky Polytechnic Institute named for Zhdanov. According to the results of these tests, efficient production scales of the new SOZh, together with wide distribution of information concerning them (by means of the publication of advertising catalogs, books, articles and journals, etc.) must be established. Broad propaganda of the importance of their application in the technology of the mechanical processes of cutting metals must be organized.

It is necessary to improve conditions for the conduct of scientific investigations with respect to the development, production and the application of contemporary effective SOZh. At the present time, this is the most important and difficult part of the entire problem. A great deal of attention is still required from Glavneftekhimperedrabotki [Main Administration for Petrochemical Refining] and from the leadership of the VNIIPKneftekhim, in order that the newly organized SOZh branch laboratory be sufficiently well established to conduct the functions of the head of scientific-research planning work in the area of liquid coolant-lubricants. In addition, work must also be conducted in the creation of methods of determining SOZh properties and of evaluating their economic effectiveness; in the development of SOZh requirements



(depending on the area of their application) and application recommendations; and to the investigation and development of various methods of SOZh application to metal-cutting machines, and also to the formulation of theoretical bases for the employment of SOZh in metal cutting. For this a laboratory is required, which, in contrast to VNIIPKneftekhim will be staffed mainly with specialists in the theory of metal cutting and physical chemistry. It is advantageous to assign the creation of the laboratory to the Ministry of Machine Tool Building and to the tool industry, because it is this organization which produces metal-cutting machines and tools and must furnish directions concerning the most advantageous technical liquid coolant-lubricant for a given operation.

It is simultaneously necessary to require the branch Technical Scientific Research Institute, and the machine building and instrument construction enterprises as well, to participate actively in the creation and study of SOZh. Liquid coolant-lubricant laboratories, of the type organized at the Gorky Automobile Plant and the Moscow factory named for Likhachev, must be organized at the leading plants of the industrial branches.

It is necessary to achieve a sharp increase in the technical level of the manufacture and use of SOZh in plants, to achieve wide application of anti-septic emulsion additives, developed at the Likhachev Plant with the purpose of lengthening the period of service, of regenerating emulsions, and eliminating loss of emulsion in water discharges. It is necessary to broaden the application of ultrasonics in the manufacture of emulsions and suspensions of high dispersion in accordance with the experience of the Voronezh Electro Technical Factory; and to increase the number and raise the qualifications of personnel solving problems related to the manufacture and application of SOZh at the plants.

The Ministries of Public Health of the USSR and the Union Republics must systematically investigate the effects of the vapors of SOZh and the products of thermal disintegration on the health of the workers, determine the permissible concentration of various aerosols in the shop atmosphere, and develop rules of hygiene with respect to the use of new SOZh.

At the present time the application of effective liquid coolant-lubricants serves as a large reserve in the intensification of the processing of metals through cutting. It must also define the scale and tempo of work in their

origination and production.

Footnotes

1. To p. 1: A liquid or gelatinous colloidal solution of high-molecular acid soaps in petroleum solvents used as a coolant-lubricant in metal cutting and working - Tr.
2. To p. 1: A surface-active substance consisting of a mixture of naphthene-sulfonic acids and alkyl-aryl sulfonic acids - Tr.